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Inservice Teachers' TPACK Development: Trends, Models, and Trajectories

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Abstract

How is experienced teachers' TPCK/TPACK developed? The full range of professional development (PD) models for inservice teachers' TPACK-related professional learning is overviewed in this chapter, classified according to eight process-focused PD approaches and 12 specific strategies, and situated within the larger (non-TPACK) PD literature. Current and probable future trends in TPACK-related PD are documented and hypothesized, mirroring, in part, nascent assertions made by other researchers that effective PD for teachers is highly contextualized, personalized, and variable in structure, purpose, orientation, and process. Recommendations for future TPACK PD research and development are then made, based upon the trends and models discussed.

Keywords:

inservice teachers, TPACK development, teacher learning, professional development models

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Introduction

Ways of helping experienced teachers develop TPACK (Koehler & Mishra, 2008) have proliferated since the construct was introduced more than a decade ago. Even some of TPACK's first appearances as technological pedagogical content knowledge (TPCK) recommended particular strategies for its development: a collaborative learning-by-design approach for inservice teachers (Koehler & Mishra, 2005) and university faculty (Koehler, Mishra, Hershey & Peruski, 2004), and instructional systems design (Angeli & Valanides, 2005) and collaborative reflection-upon-practice (Niess, 2005) approaches for preservice teachers. During subsequent years, twelve different ways of helping teachers to develop this particular type of contextualized and applied knowledge have emerged. In this chapter, these twelve strategies are overviewed and

situated within the larger teacher professional development literature, noting trends in TPACK-related teacher learning during the past decade, and probable directions for future TPACK development methods and research.

Professional Development for Teachers

Research about teachers' professional learning shows that it is most effective when it is active, reflective, sustained, job-embedded, coherent, in-depth, and focused upon students' curriculum-based learning. In particular, the success, advisability, and challenges of using collaborative and learning community-based models for professional development (PD) have been documented during the past two decades (Darling-Hammond & Richardson, 2009). Other PD models—such as coaching, mentoring, and teacher inquiry—have also been shown to be successful (Joyce & Calhoun, 2010). This literature is far from conclusive, however; teacher-learner, organizational, and contextual factors combine to form complexities that complicate what Opher & Peddler (2011) critique as a "process-product conceptualization of causality" (p. 384) within teacher professional development research that attempts to link particular characteristics of PD to improved student learning, but fails to do so consistently across multiple teacher learning contexts and systems. The efficacy of different types of professional learning approaches may well depend upon how well their content, structure, and timing fit the needs, preferences, and contextual affordances and constraints experienced by different teachers working within differing educational contexts (e.g., Pea & Wojnowski, 2014). Given this variability, it may be advisable—at least for now—to consider the full range of types of professional development for teachers, so that teacher learning can be customized for maximal efficacy.

Which approaches comprise the gamut of options for teacher PD? Few authors have attempted to organize and describe extant models for systematic, intentional teacher learning comprehensively. Joyce and Calhoun (2010) group PD types into five categories: those that support the individual teacher; those that task another teacher or administrator to provide customized professional learning opportunities; those that situate active learning within professional learning communities; those that are organized around school- or district-based curricular and/or instructional initiatives; and those that provide single-opportunity, workshop-based learning experiences for individual teachers. Kennedy (2005), situating her work within the UK's continuing professional development (CPD) movement that is occurring within multiple professions (Friedman & Phillips, 2004) organizes PD for teachers into nine models. Whereas Joyce & Calhoun's five models reference structural features of PD primarily, Kennedy's nine models focus mostly upon general purposes for teachers' learning. Kennedy's nine approaches include: training, award-bearing (e.g., certification), deficit-focused, cascading (in which teachers participating in PD teach others what they have learned), standards-based (re: government-specified standards for teachers' practice), coaching/mentoring, community of practice, action research, and transformative PD. Kennedy explains that transformative PD is actually a combination of several PD models, encompassing goals for school organizational and/or contextual change in addition to teacher learning. Rogers Park et al. (2010) classify PD approaches by their "orientations," which reflect their designers' PD knowledge, experience, and beliefs. These researchers identified five such orientations within science education PD: activity-driven, content-driven, pedagogy-driven, curriculum materials-driven, and needs-driven.

Although overall structure, purpose, and orientation for PD are important to consider, specifying particular *processes* for professional learning might be even more helpful with the logistics of planning PD, especially as it relates to a particular focus, such as developing teachers' TPACK. How might classifications of professional learning processes be described so that the full range of PD approaches that can help teachers to develop their TPACK can be considered?

To answer this question, the contents of 23 issues of the *TPACK Newsletter* (http://www.matt-koehler.com/tpack/tpack-newsletters/), dating from January 2009 (the inaugural issue) through May 2015, plus a Web-based compilation of TPCK/TPACK publications appearing prior to 2009 that was distributed prior to the first issue of the newsletter, were screened to identify all articles, chapters, conference papers, and dissertations that addressed the development of inservice teachers' TPACK or TPCK. The TPACK Newsletter is a freely available publication that is distributed by email to approximately 1200 subscribers several times each year. It contains citations and abstracts of TPACK-related articles, chapters, books, dissertations, conference presentations, and commentaries, and aims to be comprehensive in its contents. One hundred seventy-nine publications that addressed the development of inservice teachers' TPACK were found. Their contents were reviewed to identify those pieces that provided enough detailed information to deduce the design and specific processes used within the TPACK-related PD for inservice teachers that the publications were describing. Of the 179 publications, 63 contained enough information to discern the specific ways in which teachers' TPACK-related learning was supported. Thirty-five of these were selected to illustrate the distinct models of professional development that emerged from analysis of the 63 publications, based upon the clarity and comprehensiveness of the information provided in each. These 35 publications are referenced in

Table 1, grouped according to general type of and specific strategy for TPACK development. These classifications are described in detail below.

Types of TPACK Development

As the analysis of extant TPACK PD literature described above demonstrates, many approaches to TPACK development have been created and explored in the decade since the construct was named and defined. Koehler, Mishra & Cain (2013) and Koehler, Mishra, Kereluik, Shin, & Graham (2014) classify these approaches in terms of teacher knowledge-building origins and sequences. According to these authors, "PCK to TPACK" approaches help teachers to build upon existing pedagogical content knowledge to develop technological pedagogical content knowledge. "TPK to TPACK" approaches suggest that teachers begin instead with existing technological knowledge, learning to analyze and apply particular technologies in educational environments, then use that technological pedagogical knowledge to teach specific content that is well-enhanced with use of digital tools and resources. Simultaneous PCK and TPACK development approaches encourage teachers to work collaboratively in design-based ways on problems of practice with colleagues with differing sets of expertise, developing all of the aspects of TPACK interactively and emergently (Koehler, et al., 2013, p. 18).

This three-category way of conceptualizing TPACK development approaches is helpful in understanding the nature of the technology integration knowledge that teachers build when participating in these three general types of professional learning experiences. To examine the particular *strategies* that can be used to help teacher-learners to develop their TPACK, however, a more fine-grained classification system is needed. Focusing upon the different *processes* for

professional learning that have been used to assist teachers' TPACK growth, in addition to the sequences of the different types of knowledge developed (Koehler, et al., 2013), and the overarching structures (Joyce & Calhoun, 2010), purposes (Kennedy, 2005) and orientations (Rogers Park, 2010) to PD design can help researchers and teacher educators to build more comprehensive and pragmatic knowledge about approaches to and specific methods for TPACK development.

TPACK Development Approaches

At present, there are at least twelve process-based methods of TPACK-related professional learning that have surfaced in TPACK scholarship. These are overviewed in Table 1, and introduced in the paragraphs that follow. The twelve processes for TPACK development can be classified into eight general approaches: collaborative instructional design, pedagogical content knowledge (PCK)-focused learning, technological pedagogical knowledge (TPK)-focused learning, reflective/reflexive learning, problem-based learning, computer-adaptive learning, instructional planning, and workplace learning.

Collaborative instructional design

Instructional design strategies for developing teachers' TPACK (e.g., Boschman, McKenney, & Voogt, 2015; Koehler & Mishra (2005); Koehler, Mishra & Yahya, 2007) are typically constructivist in orientation, design-based in procedure, and collaborative. Using these strategies, a small group of professionals with differing and complementary expertise in curriculum/content, instruction, and educational technology typically work together to design and test an educational project, unit or course in which students will engage. Teams using this approach often revise

what they have created based upon results from formative assessments of successive implementations of what the group designed. Learning occurs for the group's participants in a "just-in-time" fashion, as designs are created, tested, and revised, according to individual professional development needs and interests.

Pedagogical content knowledge (PCK) methods

TPACK development that is PCK-focused includes methods such as instructional modeling (e.g., Jaipal-Jamani & Figg, 2014; Niess, 2005), lesson study (e.g., Groth, Spickler, Bergner, & Bardzell, 2009), peer coaching (e.g., Jang, 2010), and the collaborative development and vetting of curriculum-based instructional materials (e.g., Allan, Erickson, Brookhouse, & Johnson, 2010). These methods situate the development of teachers' TPACK within a detailed, often collaborative, analysis of teaching practice that incorporates digital tools and resources in ways that assist students' learning directly and within particular curriculum areas. PCK-focused approaches to TPACK development are often more overtly structured than collaborative instructional design approaches. Outcomes of PCK-based approaches to TPACK development can include video recorded microteaching, constructive critique of instruction, or curriculum-based, technologically infused materials to use in the classroom.

Technological pedagogical knowledge (TPK) methods

TPK-focused approaches to teachers' TPACK development are grounded in the specific educational affordances and constraints of particular digital tools, as they can be best used for content-based teaching and learning in particular disciplines. Technology mapping (Angeli & Valanides, 2009), for example, directs teachers to identify particular content-based problems of

practice (e.g., concepts that students find difficult to understand and apply) as learning objectives, then use their knowledge of available technological tools' affordances and constraints, situated within the teachers' PCK and contextual knowledge, to transform the confusing content into powerful and understandable representations for their students. TPK-focused approaches, in short, help teachers to "develop technological solutions to pedagogical problems" (Ioannau & Angeli, 2014, p. 228).

Reflective/reflexive methods

Three types of reflective/reflexive strategies for teachers' TPACK development have been documented to date. These include action research/teacher inquiry (e.g., Pierson & Borthwick, 2010); meta-analytic reflection techniques such as pedagogical practice-focused case development (e.g., Mouza & Wong, 2009) or TPACK-based learning trajectories (e.g., Niess & Gillow-Wiles, 2014); and TPACK self-assessment (e.g., Foulger, 2015; Roblyer & Doering, 2010), which can be used formatively by teachers to identify and address TPACK-related professional learning needs and progress. Although these strategies can be enacted in communication with other educators, reflective/reflexive TPACK development tends to be more focused upon a particular teacher's in-depth and ongoing reflections within a specific teaching context, while instructional design and PCK-focused TPACK development efforts are often more collaborative in process.

Problem-based methods

Similar to reflective/reflexive approaches, problem-based strategies for TPACK development often situate the focus for teachers' learning within authentic classroom and school

environments. Tee & Lee (2011, 2014), for example, ask inservice teachers who are enrolled in a graduate course to work in small teams that are formed based upon common and complex problems that they are experiencing in their classrooms. Each team then identifies multiple approaches to addressing the problem, selects/designs a solution to try, then implements it, reflecting with the group and adjusting the approach as they do so. To complete the learning cycle, team members share outcomes and reflections with all of the groups in the class in which the problem-based learning project was assigned. Although Tee & Lee (2014) reported one learning cycle in which TPACK development was the aim of their students' collaborative problem-solving, this approach to professional learning typically addresses other authentic problems of practice that are focused upon particular curricula and types of instruction into which educational technology use can be well-infused.

Computer-adaptive methods

The newest approach to TPACK development is software-based, computer-adaptive, and personalized. GeoThentic (Doering, Scharber, Miller, & Veletsianos, 2009), for example, an online geography learning environment for both students and teachers that utilizes geospatial technologies, includes a three-part teacher interface that analyzes teacher-reported, program-assessed, and user-path data to produce individualized TPACK professional learning profiles and recommended emphases for continued development. e-TPACK (Angeli, Valanides, Mavroudi, Christodoulou, & Georgiou, 2014) is a self-paced, adaptive series of curriculum- and classroom-based design scenarios at varying levels of completion that are presented to teacher-learners within a virtual environment. Users' responses to a sequence of personalized prompts about specific, contextualized instructional designs and users' self-regulated learning guide the

program's selection of scaffolding for professional learning within the system. These early explorations of personalized TPACK development show considerable promise for the role of data analytics in future TPACK-based professional learning.

Instructional planning methods

The final two approaches to TPACK development are designed to occur within the scope of teachers' daily work, rather than within a separately scheduled professional development activity, such as a graduate course or a series of after-school meetings. Bos (2011), for example, described how elementary-level teachers designing mathematics units for their students, focusing upon the pedagogical, mathematical, and cognitive fidelity of the educational resources and activities incorporated, were able to hold themselves to rigorous quality standards, despite initial frustration in locating appropriately complex and cognitively focused math online tools and resources. Their processes of problem-based unit development, plus self- and peer evaluation, helped to develop their TPACK in a holistic way.

Harris and Hofer (2006; 2009) draw upon research about teachers' planning practices to suggest a learning activities selection approach to planning lessons, projects, and units that focuses first upon curriculum-based learning goals and last upon the digital technologies to incorporate. In this on-the-job approach to teachers' TPACK development, educational technologies are chosen according to the instructional content and processes incorporated into the activity-structured learning experience being planned. Using comprehensive, freely available taxonomies of learning activity types (LATs) and corresponding recommended technologies in nine different curriculum areas (Harris, Hofer, Blanchard, Grandgenett, Schmidt, van Olphen, & Young, 2010),

teachers select, combine, and sequence multiple learning activity types based upon knowledge of their students' learning needs and preferences, curricular standards, and contextual affordances and constraints. Teachers' TPACK is built in the process of using the LAT taxonomies to plan lessons, projects, and units that incorporate educational technologies in curriculum- and pedagogically focused, educationally sound ways (Harris & Hofer, 2011).

Workplace learning methods

Along with computer-adaptive methods, contextually focused workplace-learning strategies for teachers' TPACK development (e.g., Phillips, 2014) have emerged recently. Like the instructional planning methods described above, workplace learning TPACK development occurs within and is shaped by the micro, meso, and macro contexts (Porras-Hernández & Salinas-Amescua, 2013) of teachers' and students' everyday work together in schools and communities. Unlike all of the methods described above, however, workplace TPACK learning is inherent in the "processes of identity development and practice" (Phillips, 2014, p. 254) that characterize a professional community of practice within a particular educational context. TPACK in a community of practice is "knowledge in the making" (Phillips, 2014, p. 256); it is ever-emerging, negotiated and changing among community members, and is not always coherent, consensual, or consistently enacted. As such, workplace learning may be one of the most authentic forms of TPACK development, but its progress is challenging to document and to assist, due to differing interpretations and enactments of TPACK among and between the members of a professional community.

These twelve strategies and eight approaches to inservice teachers' TPACK development are abstracted in Table 1, with sample references provided for each. As the paragraphed summaries and table contents illustrate, TPACK development strategies have proliferated in the ten years since the TPCK/TPACK construct's first appearance in research publications.

Table 1

TPACK Development Approaches and Strategies

TPACK Development Approach	TPACK Development Strategy	Description	Sample References
Collaborative instructional design	Learning by design	Educators, content experts, and technology specialists design instruction recursively, often collaboratively	Antonenko (2013); Boschman, McKenney, & Voogt (2015); Koehler & Mishra (2005); Koehler, Mishra & Yahya (2007)
PCK-focused approach	Instructional modeling; TPACK-in-practice	Teacher educator models curriculum-based, tech-infused learning experiences for students	Jaipal-Jamani & Figg (2014); Niess (2005)
PCK-focused approach	Collaborative lesson study; Peer coaching	Educators plan, observe, critique, and revise each others' teaching collaboratively	Groth, Spickler, Bergner, & Bardzell (2009); Jang (2010); Ndongfack (2015)
PCK-focused approach	Collaborative curriculum materials development	Educators co-construct tech-enhanced or –infused curriculum materials for themselves and others to use	Allan, Erickson, Brookhouse & Johnson (2010); Kafyulilo, Fisser, & Voogt (2014); Polly (2011)
TPK-focused approach	Technology mapping; game-based learning; deep-play	Educational affordances and constraints of particular devices and software applications are explored and applied to content-specific teaching and learning	Angeli & Valanides (2009; 2013); Duran, Brunvand, Ellsworth & Sendag (2012); Hsu, Liang & Su (2014); Koehler, Mishra, Bouck, DeSchryver, Kereluik, Shin & Wolf (2011)
Reflective/ reflexive approach	Teacher inquiry/Action research	Data-based, systematic exploration of teacher-identified focus in teaching and/or learning	Dawson, Cavanaugh, & Ritzhaupt (2013); Pierson & Borthwick (2010)
Reflective/ reflexive approach	Case development; learning trajectory	Meta-analytic reflection upon use of technologies in teaching, with a group of educators and/or a researcher	Mouza & Wong (2009); Niess & Gillow-Wiles (2014)

TPACK Development Approach	TPACK Development Strategy	Description	Sample References
Reflective/ reflexive approach	TPACK self-assessment; just-in-time professional development	Periodic self-assessment of extant and desired TPACK levels (all components), used to direct individualized professional learning	Foulger (2015); Roblyer & Doering (2010)
Problem-based approach	Curriculum-based, authentic problem-solving; solving problems of practice	Authentic, contextualized problem-solving using content-related technologies and/or repurposed general-purpose devices and applications	Tee & Lee (2011, 2014)
Computer-adaptive approach	Software-based, interactive, formative assessments of TPACK	Interactive, online software assesses teachers' TPACK formatively, as professional learning progresses	Angeli, Valanides, & Mavroudi, Christodoulou, & Georgiou (2014); Doering, Veletsianos, Scharber & Miller (2009)
Instructional planning approach	Learning activity types; fidelity-based unit design	Developing TPACK while focusing upon instructional planning of curriculum-based lessons, projects, or units	Bos (2011); Harris & Hofer (2006; 2009); Harris, Hofer, Blanchard, Grandgenett, Schmidt, van Olphen, & Young (2010); Polly (2011); Roblyer & Doering (2013)
Workplace learning approach	Community of practice	Teachers' TPACK is shaped by processes of identity development and practice that are contextually and communally effected and held	Phillips (2014); Porras-Hernández & Salinas-Amescua (2013)

What might the future of TPACK development be? Are there patterns that can be discerned from the first decade of work with experienced teachers?

TPACK Development Trends and Trajectories

The contents of Table 1 and their explanations suggest that, as TPACK development work has progressed over time, approaches for experienced teachers have become increasingly situated and contextualized (e.g., Phillips, 2014; Porras-Hernández & Salinas-Amescua, 2013), curriculum- and pedagogically focused (e.g., Kafyulilo, Fisser, & Voogt, 2014; Niess & Gillow-Wiles, 2014), and reflective/reflexive (e.g., Mouza & Wong, 2009; Foulger, 2015), while remaining largely collaborative (e.g., Groth, et al., 2009; Koehler & Mishra, 2005) and pragmatic (e.g., Harris, et al., 2010; Tee & Lee, 2014). These trends mirror documented developments in teacher PD overall (e.g., Opfer & Pedder, 2011) and specifically within PD for technology integration (e.g., Vrasidas & Glass, 2007). The more sustained, collaborative, and situated nature of TPACK PD that has been reported especially in recent years may indicate that shorter-term, larger-group, top-down and technocentric (Papert, 1987) approaches are being eschewed in favor of more personalized (e.g., Angeli, et al., 2014; Roblyer & Doering, 2010), curriculum-based (e.g., Jaipal-Jamani & Figg, 2014; Kafyulilo, Fisser, & Voogt, 2014) and authentic-to-the-classroom (e.g., Bos, 2011; Harris et al., 2010) methods, given researchers' and teacher educators' growing awareness of TPACK as a highly contextualized construct (e.g., Phillips, 2014).

Does this mean that we should jettison some types of TPACK PD; perhaps those approaches that are used by individual teachers instead of collaborating groups, or those that emphasize the development of TPK over TPACK? Although some PD literature might imply such action, doing so would ignore the uniqueness of different educational contexts and the differing preferences

and professional learning needs of individual teachers. As Joyce and Calhoun (2010) argue, after presenting, explaining, and illustrating their five models of PD for teachers:

> Central is the idea that there are numerous legitimate approaches to generating growth opportunities for educators. Second is the assertion that these approaches, while often having overlapping goals, such as helping all of us attain higher states of growth, favor certain goals of their own. We are not going to have "one best model," but a variety that can, in combination, have a fine impact. (p. 129)

Perhaps all of the models for TPACK PD presented in this chapter, plus those that may emerge as TPACK work continues, should be considered and used in the customized ways that Joyce & Calhoun suggest.

TPACK Development Research Trajectories

Does this recommendation contradict research results that identify common attributes of effective PD for teachers? At first, it may seem to do so. With a list of twelve strategies for developing teachers' TPACK that have emerged during the past decade now available for researchers' use, the temptation to test, contrast, and rank-order these PD methods in terms of comparative efficacy may seem like a logical next step. Before such studies are designed, however, please remember that although teacher PD literature seems to be reaching consensus about specific characteristics of effective professional development, the presence of these characteristics do not predict measurable teacher learning consistently, and some PD that is *not* characterized by many of these attributes has been empirically successful. Moreover, multiple studies of similarly structured teacher learning do not often produce replicable results across different contexts; they usually conflict in their findings (Opfer & Pedder, 2011).

Why is this so? Opfer & Pedder (2011) explain that our conceptualizations of teacher learning and the conditions that support it have, overall, been much too simplistic:

> In the context of current research on professional development and teacher learning, misunderstanding the nature of teacher learning by underplaying the complexity of the problem leads to focus on the micro context (individual teachers or individual activities or programs) to the exclusion of influences from meso (institutional) and macro (school system) contexts…. As a complex system... teacher learning becomes hard to define by aggregation and generalities because the nature of learning depends on the uniqueness of the context, person, and so on.… Relationships between elements in the system vary in scale and intensity, come together in different combinations depending on the situation, are often reciprocal, and are always nested. (pp. 378-379)

Some researchers are even beginning to suggest that teachers' knowledge (such as TPACK) is not only highly contextualized, as Opfer & Pedder explain, but also highly individualized and uniquely experientially formed. For example, Hashweh (2013), one of Shulman's doctoral students whose 1985 dissertation predated Shulman's often-cited articles about pedagogical content knowledge, asserts that PCK is not a form of knowledge that is objectively generalizable across teachers. Rather, he says that it is a collection of "private and personal," "content-specific," both general and "story-based" "pedagogical constructions" (p. 121). Specifically, Hashweh says that:

1. PCK represents personal and private knowledge.
2. PCK is a collection of basic units called teacher pedagogical constructions.

3. Teacher pedagogical constructions result mainly from planning, but also from the interactive and postactive phases of teaching.
4. Pedagogical constructions result from an inventive process that is influenced by the interaction of knowledge and beliefs from different categories.
5. Pedagogical constructions constitute both a generalized event-based and a story-based kind of memory.
6. Pedagogical constructions are topic-specific.
7. Pedagogical constructions are (or should ideally be) labeled in multiple interesting ways that connect them to other categories and subcategories of teacher knowledge and beliefs. (p. 121)

Given this highly individualized and active interpretation of PCK—extrapolated to TPCK/TPACK—the ways in which TPACK PD for teachers is offered needs to be similarly differentiated, personalized, and adaptive, which argues for potential use of a full range of different types of PD approaches and methods, as presented in this chapter.

Also, if these researchers are correct, the content of their assertions may explain some of the reasons why many studies of both PCK and TPACK have been unable to distinguish empirically among the constructs' subcomponents, such as TPK, TCK, and PK (e.g., Archambault & Barnett, 2010). Perhaps teachers' PCK and TPCK/TPACK—and the ways in which these types of professional knowledge are developed—are too contextualized and personalized to be generalizable across educators or educational contexts. This suggests that future studies of TPACK PD should describe the nature of the complex systems in which the studies are situated in enough detail so that the reported results can be appropriately and sufficiently contextualized

by readers. Perhaps some of this work could focus upon ways to determine the "fit" of particular TPACK development approaches and strategies to particular combinations of individual teacher characteristics and micro, meso, and macro workplace attributes.

Given the complexity and time-consuming nature of the research sketched tentatively above, the question of whether TPACK as an identifiable type of knowledge for teachers will disappear with time, and with it, the need for explicit TPACK development, should be addressed. Doering et al. (2009), for example, assert that

> "...despite the framework's potential usefulness, TPACK should be a temporary construct…. As technology becomes entwined in classrooms and schools, it will become braided into pedagogical knowledge, content knowledge, and pedagogical content knowledge such that the focus on technology will no longer be needed." (p. 318)

This view is in sharp contrast with that of Angeli & Valanides (2009), who see ICT-TPCK as a unique and distinct body of knowledge that requires understanding of different techologies' specific educational affordances and constraints. Cox & Graham (2009) remind us that PCK has always included technologies, and that as particular digital tools and resources become more ubiquitous in schools (and in society in general), their TPACK will be subsumed within an expanded notion of PCK. However, Cox & Graham also predict that "there will always be a need for TPACK as long as there are new, emergent technologies that have not yet become a transparent, ubiquitous part of the teaching profession's repertoire of tools." (p. 64)

Given the rapid emergence of digital technologies within the first ten years of the TPCK/TPACK construct's influence upon educational research and practice, it seems probable that for at least

the next ten years of TPACK development, inservice teachers will continue to require – and benefit from – focused, situated, authentic, and personalized ways to develop their technological pedagogical content knowledge. By purposefully choosing among and combining the strategies and approaches classified and presented here, perhaps the design and crafting of specific TPACK development efforts can become even better matched to particular teachers' professional learning needs and preferences, and the contextual realities of their workplaces.

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